BEFORE THE

PUBLIC SERVICE COMMISSION OF WISCONSIN

Application of Wisconsin Public Service Corporation for Authority to Adjust Electric and Natural Gas Rates	**)** **)** **)**	**Docket No. 6690-UR-117**

Direct Testimony of
William R. Jacobs, Jr., Ph.D.

GDS Associates, Inc.

On behalf of the

Citizens Utility Board of Wisconsin

September 1, 2005

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Exhibits:

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, TITLE AND BUSINESS ADDRESS.

A. My name is William R. Jacobs, Jr., Ph.D. I am a Principal of GDS Associates, Inc. My business address is 1850 Parkway Place, Suite 800, Marietta, Georgia, 30067.

Q. DR. JACOBS, PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND EXPERIENCE.

A. I received a Bachelor of Mechanical Engineering in 1968, a Master of Science in Nuclear Engineering in 1969 and a Ph.D. in Nuclear Engineering in 1971, all from the Georgia Institute of Technology. I am a registered professional engineer and a member of the American Nuclear Society. I have more than twenty-two years of experience in the nuclear power industry including more than twelve years of nuclear power plant construction and startup experience. I have participated in the construction and startup of seven nuclear plants in this country and overseas in management positions including startup manager and site manager. As a loaned employee at the Institute of Nuclear Power Operations (INPO), I participated in the Construction Project Evaluation Program, performed operating plant evaluations and assisted in development of the Outage Management Evaluation Program. Since joining GDS Associates, Inc. (GDS) in 1986, I have been involved in evaluation and monitoring of nuclear plant construction and operation on behalf of non-operating owners. I have also participated in rate case and litigation support activities related to nuclear power

plant construction, operation and decommissioning. I have evaluated the certification application of fossil fueled plants and have monitored the construction of gas turbine peaking plants for a state regulatory agency. My resume is included as Exhibit___(WRJ-1).

Q. WHAT IS THE NATURE OF YOUR BUSINESS?

A. GDS Associates, Inc. is an engineering and consulting firm with offices in Marietta, Georgia; Austin, Texas; Corpus Christi, Texas; Manchester, New Hampshire; Madison, Wisconsin; Manchester, Maine; and Auburn, Alabama. GDS provides a variety of services to the electric utility industry including power supply planning, generation support services, rates and regulatory consulting, financial analysis, load forecasting and statistical services. Generation support services provided by GDS include fossil and nuclear plant monitoring, plant ownership feasibility studies, plant management audits, production cost modeling and expert testimony on matters relating to plant management, construction, licensing and performance issues in technical litigation and regulatory proceedings.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING?

A. I am presenting testimony on behalf of the Citizens Utility Board of Wisconsin.

Q. WHAT WAS YOUR ASSIGNMENT IN THIS PROCEEDING?

A. My assignment was to review the forced outage at the Kewaunee Nuclear Power Plant (KNPP or Kewaunee) that began on February 19, 2005 and provide an opinion on the prudence of the management and decision-making that resulted in this outage.

Q. PLEASE DESCRIBE THE METHODOLOGY USED IN THE CONDUCT OF YOUR REVIEW.

A. In performing my review of the Spring 2005 Kewaunee outage, I reviewed extensive records and documentation prepared by Wisconsin Public Service Corporation (WPSC or the Company). These documents include testimony filed by the Company's witnesses, extensive NRC documentation, and self-assessments and corrective action plans developed by the Company. I submitted numerous data requests and reviewed the responses provided by the Company. Follow-up data requests were submitted to request additional information or clarification as needed. I utilized the Nuclear Regulatory Commission (NRC) public document room to acquire some publicly available information from the NRC. In addition, I conducted telephone interviews with Nuclear Management Company (NMC) and WPSC personnel including Mr. Craig Lambert, NMC's Kewaunee Site Vice-President, Mr. Gabe Solomon, NMC's Kewaunee Manager of Regulatory Affairs and Mr. David Molzahn, WPSC's Director of Nuclear Oversight. Mr. Lambert was in charge of all Kewaunee site activities from late January, 2005 through mid-May, 2005; Mr. Solomon was directly involved with interfacing with the NRC for approximately the same period; and Mr. Molzahn represented WPSC as an Asset Manager for Kewaunee. In summary, I used all of the relevant sources of information that were available to develop an understanding of the circumstances and conditions that led to the Spring 2005 Kewaunee outage.

Q. WHAT IS THE RELATIONSHIP BETWEEN THE NUCLEAR MANAGEMENT COMPANY AND WISCONSIN PUBLIC SERVICE CORPORATION?

A. Wisconsin Public Service Corporation and Wisconsin Power and Light Company (WP&L) were joint owners of the Kewaunee Nuclear Power Plant at the time of the Spring 2005 outage. WPSC contracted with NMC for NMC to operate Kewaunee on its behalf. In addition, WPSC was an affiliated interest of NMC during the time period addressed in this testimony.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE STATE PUBLIC UTILITY COMMISSIONS ON THE TOPIC OF NUCLEAR PLANT PERFORMANCE AND OUTAGES?

A. Yes I have. I presented testimony in Public Service Commission of Wisconsin Docket No. 6630-UR-109 concerning outages at Point Beach Nuclear Power Plant. I have also filed testimony concerning nuclear plant outages before the Public Utility Commission of Texas, the Louisiana Public Service Commission, the South Carolina Public Service Commission, the Florida Public Service Commission and the Indiana Regulatory Commission.

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. On February 19, 2005, the Kewaunee Nuclear Power Plant entered a forced outage that would last until early July 2005. After approving four Operability Recommendations in six days concluding that the required Auxiliary Feedwater (AFW) system was operable, plant personnel decided that the system was not operable and the plant was shut down in accordance with the Technical

Specifications. In recognition of the concerns related to the ability of the plant to operate safely, NMC management then developed a 19-page list of Kewaunee Improvement Initiative Commitments, many of which were required to be completed prior to startup. These commitments addressed deficiencies and concerns in a broad range of technical issues, plant processes and technical and management capabilities that required many months to complete including:

- **Operations Leadership** - Concerns with the effectiveness of operations leadership, the effectiveness of operations decision-making and the quality of operability determinations are an indication of significant management deficiencies in an operating nuclear power plant.
- **Configuration Management** - Inadequate control of configuration management is a significant management deficiency.
- **Engineering Effectiveness** - Engineering's lack of understanding of the design basis and a minimalist approach to engineering that will be discussed later are serious problems that reduce the safety margin of an operating plant.
- **Corrective Action Program Effectiveness** - NMC management of the corrective action program at Kewaunee was seriously deficient.
- **Manager / Supervisor Effectiveness** - NMC management at Kewaunee did not establish high standards, did not provide

effective oversight and did not promote conservative decision-making.

NMC's Root Cause Evaluation (RCE) of the AFW system problems that caused the plant to shut down identified the following root and contributing causes:

> **Root Cause**
> RC#1 – Engineering had a lack of knowledge and understanding of what constituted a proper rigor of analysis, review, or documentation when resolving issues related to design basis for the AFW pumps.
>
> **Contributing Cause(s)**
>
> SC#1 – There was a lack of commitment at the site to adequately develop and install the modification to provide automatic protection to the AFW pumps from a loss of suction.
>
> SC#2 – Weak program and process guidance and expectations over time have hindered the site in fulfilling obligations.
>
> SC#3 – Poor planning and issue management resulted in issues not being properly addressed in a timely manner and involved numerous items of rework based on promptings by the NRC.

NMC management was imprudent in allowing the quality and effectiveness of critical programs and processes to decline to the point that the extensive effort outlined in the March 18th commitment letter was necessary to convince the NRC and plant owners that the plant design was understood, the plant was capable of safe operation and that NMC personnel were capable of managing and operating the plant safely.

II. PRUDENCE AND FUEL RULES DEFERRAL STANDARDS

Q. PLEASE DESCRIBE THE PRUDENCE STANDARD THAT YOU APPLIED IN YOUR REVIEW OF THE KEWAUNEE NUCLEAR POWER PLANT OUTAGES.

A. I have applied the standard of prudence that is essentially a "reasonable man standard" in that the utilities' actions or decisions are compared to the reasonable actions or decisions of a qualified and experienced utility manager given what was known, or reasonably should have been known, at the time without benefit of hindsight. This is the standard that has been adopted by many regulatory agencies. In its Amended Findings of Fact, Amended Conclusions of Law and Conditional Order in Docket 6630-UR-109 dated December 23, 1997, the Public Service Commission of Wisconsin cited the definition of prudence used by the Court of Appeals in Wisconsin Public Service Corporation vs Public Service Commission, 156 Wis. 2d 611, 617 (Ct. App. 1990) which defined "prudence" as:

> Carefulness, precaution, attentiveness and good judgment, as applied to action or conduct….This term, in the language of the law, is commonly associated with "care" and "diligence" and contrasted with "negligence."

The Commission further states:

> Imprudence, according to the court, is the waste of assets, the lack of caution, the failure to take reasonable steps to protect assets.

My reasonable man standard incorporates these concepts cited by the Commission in Docket No. 6630-UR-109.

Q. WHAT ARE THE LEGAL STANDARDS FOR A UTILITY TO QUALIFY FOR A DEFERRAL OF ITS EMERGENCY FUEL EXPENSES UNDER WIS. ADMIN. CODE PSC 116?

Under PSC 116.06, a utility must experience an emergency to qualify for a deferral. "Emergency" is defined under the fuel rules to mean, in part, an event that is caused suddenly by forces beyond the utility's control or reasonable foresight.

Q. HAS THE PSC GRANTED WPSC APPROVAL FOR DEFERRAL ACCCOUNTING FOR THE UTILITY'S REPLACEMENT POWER COSTS INCCURED AS A RESULT OF THE SPRING 2005 KEWAUNEE OUTAGE?

A. Yes, the PSC granted this approval in a letter order dated March 17, 2005, in Docket 05-GF-149. The letter order made plain that the authorization was for accounting purposes only, and that it did not "bind the Commission to any specific treatment for this item in any future proceeding involving rates or other matters before the Commission."

III. DESCRIPTION OF THE SPRING 2005 KNPP OUTAGE

Q. WHY WAS KEWAUNEE SHUT DOWN ON FEBRUARY 19, 2005?

A. As the result of questions received during an NRC inspection, Kewaunee's operators, the Nuclear Management Company, concluded that the Auxiliary Feedwater pumps were not operable and, in accordance with the Technical Specifications governing operation of the plant, Kewaunee was shut down. In the nuclear power industry the term "operable" means that a piece of equipment is able to perform its safety related functions under all potential accident conditions as defined in the plant's licensing basis. If a specific piece of equipment required for continued operation by the Technical Specifications is found to be not operable, the plant must shut down.

Q. PLEASE DESCRIBE THE NRC INSPECTION THAT LED TO THE QUESTIONS CONCERNING THE OPERABILITY OF KEWAUNEE'S AFW PUMPS.

A. In 2004 the NRC initiated a program to improve its ability to identify significant design issues at commercial nuclear power plants. Phase 2 of this program involved development of a new inspection approach and conduct of four pilot inspections. The NRC staff developed a prototype inspection model that focused on aspects of a plant's design that represented a relatively high degree of risk and for which there appeared to be a relatively low margin. In this context the term "low margin" means in an accident condition, the component or system must operate at or near its full capacity with little room for operator error or equipment

malfunction. The NRC conducted one of these so-called "High Risk / Low Margin" inspections in each of the four NRC regions. The inspections were conducted at Vermont Yankee, V.C. Summer, Kewaunee and Diablo Canyon nuclear plants.

Q. WAS KEWAUNEE THE FIRST PLANT TO UNDERGO THIS TYPE OF NRC INSPECTION?

A. No, it was not. Kewaunee was the last of the four plants for which the NRC conducted the "High Risk / Low Margin" inspection. The fact that three other similar inspections were conducted prior to Kewaunee and that the Kewaunee staff discussed the inspections with the staffs of the plants inspected prior to Kewaunee should have given the staff of Kewaunee an advantage in preparing for the inspection.

Q. HOW DID THE INSPECTION RESULTS AT KEWAUNEE COMPARE WITH THE INSPECTION RESULTS AT THE OTHER THREE PLANTS?

A. The NRC identified 9 violations of NRC requirements at Kewaunee, the most findings of any of the plants. Kewaunee also had the only finding that was determined to be a Severity Level IV finding. And most significantly, Kewaunee was the only plant for which concerns raised by the NRC during the inspection caused the plant to shut down to resolve the concerns. The issues with the Auxiliary Feedwater System that resulted in the plant shutdown are described in more detail below. The NRC's report SECY-05-0118 on the results of the High Risk/Low Margin inspections is provided as Exhibit____(WRJ-2).

Q. PLEASE DESCRIBE IN MORE DETAIL THE SEQUENCE OF EVENTS THAT LED TO THE AFW PUMPS BEING DECLARED INOPERABLE.

A. The AFW pumps must be operable to cool down the plant in the event of certain postulated accident scenarios. Inability to cool the plant down using the AFW pumps could lead to a serious accident including core melting under some conditions. Following the Three Mile Island event in 1979, the NRC issued NUREG-0737, which required nuclear plant owners to take additional steps to ensure that the AFW pumps would remain operable during postulated seismic and tornado events. In 1994, WPSC added a discharge pressure trip to the AFW pumps to protect the pumps from a loss of suction by tripping the pumps when the discharge pressure decreased to a prescribed level. The sequence of events leading to the shutdown of Kewaunee on February 19, 2005 is described below:

- On January 24, 2005, in preparation for the NRC inspection, NMC personnel initiated a corrective action document (CAP025124) to document the lack of a definitive basis for the AFW pump discharge pressure trip setpoints.
- Three days later on January 27, 2005, the NRC asked NMC personnel if the potential for air ingestion had been considered when the discharge pressure trip setpoints were established. The NRC was concerned that the discharge pressure switches would not detect air ingestion until significant damage to the pumps had occurred.
- On February 4, 2005, NMC initiated CAP025341 which stated that NMC could not demonstrate that the AFW pumps would be protected if the

supply from the Condensate Storage Tanks or the suction piping failed. This CAP however concluded that the AFW system was operable. Following issuance of CAP025341, NMC issued a series of Operability Recommendations all concluding that the AFW system was operable.

- On February 7, 2005, NMC approved Operability Recommendation (OPR) OPR-87, Revision 0 which concluded that the AFW system was "operable but degraded." OPR-87, Rev. 0 stated that no compensatory measures were needed to maintain operability and relied on existing operating procedures. The NRC questioned this conclusion because the normal operating and emergency procedures were developed based on normal depletion of the Condensate Storage Tank inventory during non-seismic or tornado events.
- On February 8, 2005, NMC approved Revision 1 to OPR-87 still stating that no compensatory measures were needed but included additional measures to provide a dedicated control room operator and procedure changes to transfer the suction of the AFW pumps to the safety grade service water system sooner in the event of an earthquake or tornado strike.
- On February 9, 2005, NMC approved Revision 2 of OPR-87 providing discussion to support an additional conclusion that if suction to the AFW pumps was lost there was a reasonable assurance that the pumps would not be damaged before the discharge pressure trips stopped the pumps.

- On February 11, 2005, NMC declared the discharge pressure trips on all three AFW pumps to be inoperable based on vendor analyses of potential tornado damage to the Condensate Storage Tanks and the potential for damage of the AFW pumps due to air ingestion before they would be tripped by the discharge pressure trips. NMC initiated compensatory measures.
- On February 12, 2005, NMC declared the discharge pressure trips to be operable but non-conforming.
- On February 13, 2005, NMC approved Revision 3 of OPR-87 which addressed the compensatory measures. The NRC continued to question the technical bases for the conclusions stated in Revision 3 of OPR-87.
- Finally, on February 19, 2005, NMC determined that the AFW pump suction piping was susceptible to damage from a high-energy line break in the turbine building. NMC declared all three AFW pumps inoperable and began to shut down the plant in accordance with the Technical Specification requirements. The issue of AFW system operability was considered to be an unresolved item (URI) by the NRC. A copy of the NRC inspection report is provided as Exhibit____(WRJ-3). A discussion of the AFW issue begins on page 22 of this inspection report.

Q. HOW WOULD YOU CHARACTERIZE THIS SEQUENCE OF EVENTS?

A. Most nuclear power plant operators try very hard to find problems in their plants themselves before they are discovered by the NRC or other oversight agency. The fact that the AFW pump problem was initially identified only after numerous

questions by the NRC inspectors during the High Risk / Low Margin inspection and the fact that NMC approved four revisions of the Operability Recommendation within 6 days all declaring the pumps to be operable only to declare the pumps as inoperable and shut down the plant 6 days later could not have filled the NRC with confidence in NMC's ability to correctly and conservatively determine the operability status of critical plant equipment.

IV. THE RESTART COMMITMENT LIST

Q. DID NMC IDENTIFY MORE ISSUES IN ADDITION TO THE AFW CONCERNS THAT WERE REQUIRED TO BE RESOLVED PRIOR TO RESTARTING THE UNIT?

A. Yes, NMC management identified many additional issues and concerns that required resolution before the plant could be restarted. Beginning shortly after the plant shutdown, NMC management began work on developing a list of additional concerns and issues that would need to be resolved prior to restarting the unit. NMC discussed this list of issues with the NRC in early March and formally presented the Commitment List to the NRC in a March 18, 2005, letter from Site Vice-President Craig Lambert. The Commitment List is 19 pages long and identifies specific objectives and actions to be completed in the following areas:

- Operations Leadership
- Configuration Management
- Engineering Effectiveness
- Corrective Action Program Effectiveness
- Manager / Supervisor Effectiveness

The Commitment List included activities required to be completed before startup and other activities that would be completed after startup. A copy of the March 18th Commitment List is included as Exhibit____(WRJ-4). Exhibit____(WRJ-5) is a flowchart depicting the major activities required to be completed prior to startup that was provided in response to Data Request 2-CUB-13. This flowchart

clearly illustrates the magnitude and complexity of issues requiring resolution prior to restarting the unit. As will be discussed in detail later in this testimony, restart of the unit was not based on NMC's resolution of a narrow technical issue or equipment problem but rather required that NMC resolve and revalidate a broad array of management concerns, programs and processes needed to ensure safe operation of the Kewaunee plant.

Q. WHY DID NMC DEVELOP THIS COMMITMENT LIST?

A. Following the shutdown on February 19, 2005, NMC management perceived that the issues related to the AFW pump problems were symptomatic of much broader management and programmatic weaknesses at the Kewaunee plant. Management decided that the best approach was to identify these issues themselves and present the list of issues and proposed actions for resolution to the NRC. As stated by Mr. Molzahn, NMC wanted to "keep the keys to the car in their control" rather than turning over control of the outage and requirements for startup to the NRC.

Q. PLEASE CHARACTERIZE THE CONCERNS THAT WERE INCLUDED IN THE MARCH 18th COMMITMENT LETTER.

A. The areas of concern that NMC identified in the March 18th Commitment Letter encompass the fundamental management functions and programmatic processes that are critical to the safe operation of a nuclear power plant. Significant concerns in any of these areas bring into question the ability of the plant to operate safely. Note that the actions required by the Commitment List below are indicative of concerns that NMC management identified as issues that must be

addressed to demonstrate to the NRC and to themselves that the plant could be operated safely.

Q. PLEASE DESCRIBE THE CONCERNS AND REQUIRED ACTIONS IN THE AREA OF OPERATIONS LEADERSHIP.

A. The following NMC commitments addressed concerns with the operations leadership and conduct of operations:

Operations Leadership

- Implement NMC Fleet Operations Mentoring Program to improve Conduct of Operations (item 1.a)
- Raise standards of performance within operations (item 1.b)
- Improve understanding of what an Operations-led organization looks like (item 1.c)
- Improve Operations training (item 1.d)
- Improve the effectiveness of operational decision-making (item 1.e)

Operability Determinations

- Improve the quality of Operability Determinations (item 2.a)
- Validate the quality of existing open Operability Determinations (item 2.b)

Conduct of operations and operations leadership must function at a high level of performance to drive safe plant operations. The operations department should provide leadership for the rest of the plant staff. Operations personnel must be able to determine if required equipment is able to perform its design function and

meets the requirements for operability. Concerns with the effectiveness of operations leadership, the effectiveness of operations decision-making and the quality of operability determinations are an indication of significant management deficiencies in an operating nuclear power plant.

Q. PLEASE DESCRIBE THE CONCERNS AND REQUIRED ACTIONS IN THE AREA OF CONFIGURATION MANAGEMENT.

A. In the nuclear power industry the term Configuration Management means that the design of the plant is maintained such that the plant must be able to operate and shut down safely under any of the design basis events assumed in the safety analysis and that the actual plant in the field must be the same as the plant design. NMC committed to re-validate the plant design and installation by the following actions:

Extent-of-Condition Reviews – The Extent-of-Condition Reviews determined the degree that the plant and plant design met NRC and safety analysis requirements by doing the following:

- Confirm that prior NRC commitments have been implemented as required (item 3.a).
- Confirm that assumptions made in critical engineering calculations, that require operator actions to be performed within specific times, reflect actual operator times (item 3.b). That is, confirm that operators can in fact perform the actions required for safe plant operation within the time assumed for these actions.

- Provide reasonable assurance of design basis compliance with high energy line breaks, tornados, flooding and seismic events (item 3.c)

Auxiliary Feedwater and Turbine Building Flooding Modifications

- Resolve auxiliary feedwater system operability concerns due to the loss of suction from the Condensate System (item 4.a)
- Address the turbine building flooding concerns (item 4.b)

Design Basis Documentation Validation

- Validate and improve documentation of the design basis for (item 5.a):
  - Internal Flooding
  - High Energy Line Breaks
  - Station Blackout
  - Tornados
  - Seismic Events
- Complete documentation and validation of the license bases for the safety functions of the most risk significant systems (item 5.b)
- Improve retrievability and control of calculations of record (item 5.c)

Electrical Calculations

- Complete AC electrical models and calculations to provide clear bases for safety related settings and loads (item 6.a)

- Complete DC electrical models and calculations to provide clear bases for safety related settings and loads (item 6.b)

The design of the plant can change over time as design changes and modifications are implemented. The plant in the field can also change through maintenance activities. The configuration management program must ensure that the plant, as designed and as installed, can cope with any credible accident scenario. Failure to maintain the plant configuration such that the design and physical plant can safely cope with any accident scenario represents a significant safety concern. Issues discovered during the NRC inspection and subsequent reviews caused NMC management to question the state of configuration management at Kewaunee. Extensive system reviews and walk downs were required to revalidate the plant design and installation. Inadequate control of configuration management is a significant management deficiency.

Q. PLEASE DESCRIBE THE CONCERNS AND REQUIRED ACTIONS IN THE AREA OF ENGINEERING EFFECTIVENESS.

A. The NMC Commitment List required improved engineering effectiveness in the following areas:

- Improve the quality of Engineering products (item 7.a)
- Improve Engineering knowledge and understanding of design and licensing bases (item 7.b)
- Improve the interface between Operations, Maintenance and Engineering (item 7.c)

A high quality engineering program is required for safe nuclear plant operation. In order to safely design plant modifications, engineering must completely understand the design and licensing bases for the plant. Safe operation of the plant relies on engineering to understand the plant design and the reasons behind specific design features, to develop solutions to plant problems that do not compromise the design basis, and to design plant modifications that maintain and enhance the ability of the plant to operate safely. Engineering's lack of understanding of the design basis and a minimalist approach to engineering that will be discussed later are serious problems that reduce the safety margin of an operating plant.

Q. PLEASE DESCRIBE THE CONCERNS AND REQUIRED ACTIONS IN THE AREA OF CORRECTIVE ACTION PROGRAM EFFECTIVENESS.

A. The March 18th NMC Commitment List identified the following concerns and actions related to the corrective action program.

<u>Initiation and Screening Effectiveness</u>

- Ensure station personnel are aware of their roles and responsibilities in the Corrective Action Program (CAP) (item 8.a)
- Validate appropriateness of the significance level assigned for all currently open conditions adverse to quality in the Corrective Action Program (item 8.b)
- Assure CAP trends are identified and used in the significance and level effort assigned during CAP screening (item 8.c)

- Assure that managers recognize the significance of long-standing issues (item 8.d)

CAP Resolution Effectively Addresses Problems

- Improve the quality of Apparent Cause Evaluations (ACEs) (item 9.a)
- Assure corrective actions have effectively resolved the issues (item 9.b)

Timeliness of Resolution of Significant Issues

- Validate the timeliness for resolution of current open significant issues (item 10.a)
- Assure operable but degraded / non-conforming issues are corrected in a timely manner (item 10.b)

An effective corrective action program is one of the cornerstones of a well-managed and safely operated nuclear power plant. An effective corrective action program must have the following attributes:

- Timely identification of plant problems
- Recognition of the significance of plant problems
- Timely development of corrective actions to resolve problems
- Development of effective corrective actions that resolve the problem and prevent reoccurrence.

The corrective action program at Kewaunee exhibited few of these attributes. Many problems were long-standing and significant to plant safety. Prior corrective actions were ineffective in resolving the problems or failed to address

the full scope of the problem. A nuclear plant cannot be safely operated without an effective corrective action program. NMC management of the corrective action program at Kewaunee was seriously deficient.

Q. PLEASE DESCRIBE THE CONCERNS AND REQUIRED ACTIONS IN THE AREA OF MANAGER AND SUPERVISOR EFFECTIVENESS.

A. NMC identified the following objectives in the Commitment List:

Individual Behavior Excellence

- Communicate Kewaunee "Picture of Excellence" to employees to help facilitate sustained performance improvement (item 11.a)
- Provide the necessary infrastructure and tools required to execute and reinforce the "Picture of Excellence" (item 11.b)

Leadership Capabilities

- Improve the leadership capability of supervisors in (item 12.a):
  - Operations
  - Operations Training
  - Engineering

Nuclear Oversight Effectiveness

- Improve Nuclear Oversight effectiveness (item 13.a)

Conservative Decision-Making

- Improve understanding of conservative decision making by managers and supervisors (item 14.a)

All aspects of safe nuclear plant operation rely on effective managers and supervisors. Managers and supervisors establish the acceptable level of

performance for all plant personnel and hold personnel accountable for their actions. They must provide the necessary tools and infrastructure to achieve the required level of performance. NMC management at Kewaunee did not establish high standards, did not provide effective oversight and did not promote conservative decision-making.

Q. DID NMC PRESENT THESE COMMITMENTS TO THE NRC IN A FACE-TO-FACE MEETING?

A. Yes. NMC made a presentation entitled "Kewaunee Improvement Initiatives" to the NRC Region III on April 20, 2005. A copy of the presentation slides is attached as Exhibit____(WRJ-6). As shown on page 3 of the presentation slides, the purpose of the meeting was to discuss how Kewaunee arrived at its present condition, discuss the Kewaunee Improvement Plan and establish a common understanding of near-term actions to be completed prior to restart and long-term actions to be completed after restart. NMC presented an overview of the issues identified including ongoing issues with operations leadership, engineering rigor and physical configuration questions such as flooding. It also identified issues that were identified during the NRC Design Margin Inspection review of the AFW system including design modification issues and system questions such as the impact of High Energy Line Breaks, seismic impact and tornado protection. NMC described the Extent-of-Condition reviews which would be implemented to revalidate the critical safety systems. NMC summarized the results of the Internal/External Hazards Review as shown below:

Hazard Area	Potential Discrepancy Summary
High Energy Line Break	51 potential discrepancies; 31 researched – no action required 13 in corrective action program 7 require resolution prior to restart 2 under evaluation
Seismic	33 potential discrepancies; 20 researched – no action required 13 in corrective action program 4 require resolution prior to restart 0 under evaluation
Tornado	12 potential discrepancies; 11 researched – no action required 1 in corrective action program 1 requires resolution prior to restart 0 under evaluation
Internal Flooding	In Progress

NMC also presented changes in the site leadership, which included new managers in the positions of Site Vice President, Improvement Programs Director, Nuclear Oversight Manager, Design Engineering Manager, Training Manager, Regulatory Affairs Manager, Operations Manager and Outage/Scheduling Manager.

Q. WAS IT NECESSARY TO ADDRESS THESE ISSUES TO CONVINCE THE NRC THAT THE PLANT WAS SAFE TO OPERATE?

A. Yes it was. The issues identified during the NRC High Risk / Low Margin inspection had widespread implications about the effectiveness of critical engineering and management programs and processes. However, as Mr. Molzahn stated in his interview, in addition to convincing the NRC that the plant could be operated safely, this broad review of issues was necessary to convince the plant owner that Kewaunee could be operated safely. In fact, additional concerns with

safety-related equipment that could have resulted in a plant shutdown were identified during the extent-of-condition reviews conducted in accordance with the Commitment List.

Q. PLEASE BRIEFLY DESCRIBE THE ADDITIONAL PROBLEMS IDENTIFIED AFTER COMPLETION OF THE NRC INSPECTION.

A. The extent-of-condition reviews and other analyses conducted by NMC identified a number of significant problems at Kewaunee after the NRC High Risk / Low Margin inspection was completed. These are described briefly below and in more detail in the attached Licensee Event Reports (LERs).

- **Safe Shutdown Potentially Challenged by Unanalyzed Internal Flooding Events and Inadequate Design** – On May 15, 2005, NMC personnel determined that the Kewaunee plant design would not ensure that required safety related equipment would not be protected from the failure of non-safety related piping in the turbine building. The causes of this condition are discussed later in this testimony in the review of the Root Cause Evaluation. LER 2005-004-00 is attached as Exhibit____(WRJ-7).

- **Emergency Diesel Generator Exhaust Not Adequately Protected from Potential Tornado Winds and Missiles** – The design of Kewaunee is such that sections of Turbine Building metal siding are designed to blow out or blow in due to tornado wind loading. However, on March 24, 2005, NMC discovered that loss of this siding would expose the Class 3 portion of the A and B Emergency Diesel Generator (EDG) exhaust ductwork to tornado wind loads. Additional evaluation on April 19, 2005 determined that the EDG exhaust ductwork was also susceptible to turbine and tornado missiles. Deformation of the exhaust ductwork could result in reduction of EDG capacity due to an increase in exhaust backpressure. A number of modifications were required to ensure the structural integrity of the exhaust duct and its supporting systems. Additional detail on the issue is provided in LER 2005-005-00 attached as Exhibit____(WRJ-8).

- **Unanalyzed Condition: Design Deficiency – Component Cooling Water System Inoperable Due to Pump "Run Out" Conditions** – On March 28, 2005 a past operability concern was

identified. On January 23, 2002, plant personnel identified a potential "run out" concern with the Component Cooling Water pumps. Under certain conditions, there was the potential that pump "run out" and damage to the operating Component Cooling Water pump could occur. Pump run out occurs when the pump operates at higher than design flow due to inadequate backpressure. Plant design changes have been implemented to alleviate the pump run out concern. Additional information is provided in LER 2005-007-00 attached as Exhibit____(WRJ-9). The LER does not discuss why this condition went unresolved for over three years.

- **Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Insufficient Net Positive Suction Head** – On April 20, 2005, NMC determined that the turbine-driven auxiliary feedwater pump would have been rendered inoperable due to insufficient net positive suction head following a postulated main steam line break event. Auxiliary Feedwater system changes including suction pressure protection, revised discharge pressure switch settings and procedure changes were required to resolve this problem. More detail on this condition is provided in LER 2005-008-00 attached as Exhibit____(WRJ-10).

Q. WOULD ANY OF THESE PROBLEMS HAVE RESULTED IN A SHUTDOWN HAD THE PLANT BEEN IN OPERATION WHEN DISCOVERED?

A. Yes, it is likely that several of these issues would have caused the plant to shut down if they had been identified when the plant was operating. I posed this question to Site Vice President Craig Lambert. Mr. Lambert opined that "the EDG ductwork issue would have required a shutdown, the tornado missiles could have caused a shutdown and the turbine building flooding may have required a shutdown."

Q. HAS NMC DEVELOPED A DETAILED EVALUATION OF THE CAUSE OF THE AUXILIARY FEEDWATER ISSUE AND TURBINE BUILDING FLOODING ISSUES?

A. Yes. NMC has issued Root Cause Evaluation (RCE) 677 / 681 which addresses the AFW pump air entrainment issue and RCE 685, which addresses the turbine building flooding issue. A review of these reports is informative as they not only discuss specific technical concerns related to these issues but they also address the management and programmatic issues that allowed these long-standing issues to exist.

Q. PLEASE REVIEW THE FINDINGS OF RCE 677 / RCE 681, REVISION 2, AFW PUMPS SUSCEPTIBLE TO DAMAGE FROM AIR ENTRAINMENT.

A. This root cause evaluation provides a comprehensive review of this event including a narrative of the event, the assessment resulting from the Extent-of-Condition review, a discussion of previous similar events, the nuclear safety significance of the event and the root and contributing causes of the event. This RCE is particularly significant as the susceptibility of the AFW pumps to damage from air entrainment is the issue that resulted in the shutdown of the plant on February 19, 2005, and the findings are illustrative of the engineering, management and programmatic problems that existed at Kewaunee. The primary and contributing root causes identified for AFW pump air entrainment susceptibility issue in NMC's RCE 677 / RCE 681 are presented below:

AFW Pump Air Entrainment Susceptibility Root Causes

Root Cause
RC#1 – Engineering had a lack of knowledge and understanding of what constituted a proper rigor of analysis, review, or documentation when resolving issues related to design basis for the AFW pumps.

- Lack of detail in design basis for DCR 2668 for switching from suction trips to discharge pressure trips.

- Modification that was installed to protect the AFW pumps was only focused on one aspect of failure mechanism and did not take into account all effects from that failure mechanism.

- Mindset that discharge pressure switches and transport time were adequate to protect the pump influenced the site's failure to recognize OE related air entrainment issues with respect to the AFW pumps.

- Lack of documented analysis and basis for setpoints of discharge pressure trips.

- Inadequate use of vendor documentation for an unrelated but similar issue without documented follow-up with the vendor to ensure applicability.

- There was an inadequate understanding of the work that needed to be performed and the significance of not performing the modification related to installation of the suction pressure trips and as such the modification was delayed almost 10 years before it was realized that a commitment was not satisfied and the AFW pumps were not protected.

- Failure to ensure that the modification for the low suction pressure switches contained adequate documentation on the basis for changing the scope of the modification and the basis for the setpoints for the discharge pressure switches even after the 1997 SOPI where the NRC questioned these setpoint bases.

Contributing Cause(s)

SC#1 – There was a lack of commitment at the site to adequately develop and install the modification to provide automatic protection to the AFW pumps from a loss of suction.

- Long-standing resistance to installing modification for low suction pressure switches over a 10-year period.

- Clear language in letter that committed to installing the AFW suction pressure trips that indicated the site still believed there would only be a minimal increase in benefit.

- Minimalist approach to implementation of AFW protection scheme.

- Inadequate use of vendor documentation for an unrelated but similar issue without documented follow-up with the vendor to ensure applicability.

SC#2 – Weak program and process guidance and expectations over time have hindered the site in fulfilling obligations.

- The commitment-tracking program was an inadequate tracking mechanism to ensure that the commitment made to the NRC was fulfilled.

- Due dates were not given/enforced and communication with the NRC was lacking in relation to low suction pressure trip modification in the 1980s and 1990s.

- The standards and expectations used 12 years ago were weaker than current standards and expectations and it is generally recognized that the site has historically had a strong "knowledge of the craft" culture in the past.

- The site was a stand-alone plant relying on internalized inputs and resolutions more than external inputs and guidance for issue resolution.

SC#3 – Poor planning and issue management resulted in issues not being properly addressed in a timely manner and involved numerous items of rework based on promptings by the NRC.

- Repeat prompting by the NRC for updates related to GL-4 went effectively unanswered for several correspondences.

- The site did not install the modification in a timely manner, referring to evaluations being performed for PRA and IPE as justification for delays and proof that only a marginal increase in safety would be obtained by installing the modification.

- It took four years to perform evaluation for GL-4 that the site said would be evaluated in 90 days.

As seen from this list, RCE 677 / 681 provides specific examples of many of the management and programmatic issues that were identified in the March 18th NMC Commitment List including:

- Engineering lack of knowledge and understanding of what constituted proper rigor of analysis, review and documentation when dealing with design basis issues
- Lack of documented analysis and bases for setpoints
- Lack of understanding of the significance of safety related issues
- Lack of timely implementation of required modifications
- A minimalist approach to engineering
- Weak program and process guidance
- Low expectations
- Inadequate commitment tracking program

A complete copy of RCE 677 / 681 is attached as Exhibit____(WRJ-11).

Q. DID NMC IDENTIFY SIMILAR PROBLEMS RELATED TO THE TURBINE BUILDING FLOODING ISSUE?

A. Yes, they did. The following root causes and contributing causes for the Turbine Building Flooding issue were identified by NMC:

<u>Turbine Building Flooding Root Causes</u>

Root Causes:

RC1 – When told we have problems, the site does not recognize the possible significance of the problem and apply the appropriate actions commensurate with the significance of the problems to fix them.

RC2 – KNPP personnel have developed a minimalist approach to making changes.

Contributing Causes:

SCF-1 – The Probabilistic Risk Assessment (PRA) model was flawed and KNPP's Individual Plant Examination (IPE) submittal was found reasonable and acceptable.

SCF-2 – Only a limited assessment was conducted on information (Significant Operating Experience Reports, Operating Experience).

SCF-3 – Low level of knowledge in engineering related to design basis.

SCF-4 – Design basis related to internal flooding is vague with little or no supporting evidence available.

As in RCE 677 / 681, this root cause evaluation identifies NMC's lack of ability to recognize the significance of a problem and take appropriate corrective action, a minimalist approach to engineering and a lack of understanding and low level of knowledge related to design basis concerns. RCE 685 is provided as Exhibit____(WRJ-12).

Q. HAVE THERE BEEN OTHER RECENT EXAMPLES OF SIMILAR ISSUES?

A. Yes. During the 2004 refueling outage, NMC opened the equipment hatch to facilitate replacement of the KNPP reactor vessel head. To facilitate movement of the old and new reactor vessel heads, NMC installed a runway system. NMC designed the runway system with a splice such that the portion of the runway that extended through the equipment hatch opening could be removed to allow for closure of the hatch when required. When NMC attempted to close the equipment hatch approximately 6 days into the outage they discovered an interference between the remaining interior runway beam and the equipment hatch door that prevented closing of the equipment hatch. The interference would have delayed closure of the hatch beyond the time it would take for boiling in the core to occur if cooling to the core was lost. Boiling in the core with the equipment hatch open and the reactor vessel head removed for refueling would allow an uncontrolled

release of radioactive material to the containment building and the environment.

Root Cause Evaluation 668 identified the following root causes for this event:

Root Causes:

Cause 1 – Site personnel do not always recognize what constitutes a potentially risk significant or consequential condition outside of the Technical Specifications or licensing basis.

Cause 2 – Kewaunee has selectively incorporated elements of industry guidance documents such as NEI, NUMARC, INPO, SDP, etc. without a sound documented basis for not incorporating the parts of the recommendations or guidance that the sites determine are not necessary.

Once again, NMC's root cause evaluation cites failure to recognize a potentially risk-significant issue and failure to adequately document the bases for decisions as root causes of a significant site event.

Q. ARE THE ISSUES THAT CAUSED THE SPRING 2005 OUTAGE AT KEWAUNEE NEW ISSUES OR ARE THEY LONG-STANDING PROBLEMS THAT HAVE NOT BEEN ADEQUATELY ADDRESSED?

A. The issues that caused the Spring 2005 outage are long-standing issues that have been previously identified and not adequately addressed. RCE 677 / 681 and RCE 685 identified many examples of long-standing problems that WPSC or NMC did not identify and correct. Concerning Design Basis Documentation, RCE 685 states[1]:

> **Design Basis Documentation**
> The knowledge that the design basis documentation at the site lacks rigor in detail and documentation is a legacy issue that has been known for several years as indicated by INPO

[1] Kewaunee Nuclear Power Plant, RCE 685 Flooding Mitigation / Controls Systems Root Cause Evaluation, dated July 22, 2005, pages 15 - 16

2000 data and 2001 GAP Analysis, INPO 2002 findings and INPO 2004 E&A visits among other references.

GAP Findings (used input for INPO 2000, WANO, Self Assessments, NRC, etc.)

The GAP determined that there were many areas at the site that did not align with industry standards and included the following areas related to design basis:

- Design Change Process
- Design Basis Documents Program
- Calculation Process

2002 INPO Findings

- AFI EN.2-2#2 – Some engineering design calculations and evaluations are not sufficiently supported and lack the rigor and documentation necessary to justify the results. In addition, other engineering products, such as safety evaluations and design packages are sometimes not thoroughly supported or documented.
- AFI EN.2-3 – Insufficient understanding of design related information by station personnel and narrowly focused corrective actions for identified design deficiencies contribute to late recognition of some safety-related systems not meeting design requirements.

CE 15745, Common Cause Analysis of 7 recent events found the following common causes[2]:

- Managers have not been educated in the creation of expectations and actions that will result in improvement and recurrence control
- When told we have problems, the site does not recognize the possible significance of the problem and apply the appropriate actions commensurate with the significance of the problems to fix them

The KNPP Operations Assessment (GAP Analysis) in 2001 noted the following items[3]:

[2] Kewaunee Nuclear Power Plant, RCE 685 Flooding Mitigation / Controls Systems Root Cause Evaluation, dated July 22, 2005, pages 18 - 19

- Functional Area Summary for the Engineering Group states, "The KNPP design basis is not well documented, is not defined, and is difficult to find." (p3)

- Operations and Engineering "Engineering is weak (loss of talent) or lacks alignment with operational priorities" and "Design basis is not a priority and design margins erode over time" (p5)

- Self-Critical "Self assessment processes do not find problems or do not address them" (p5)

The concerns and issues that led to the Spring 2005 outage and were identified in the March 18th Commitment List have existed and been recognized for many years. The following eerily familiar quote is taken from the cover letter to an NRC Inspection report dated March 28, 1997. The inspection focused on the Residual Heat Removal system and the Auxiliary Feedwater system at Kewaunee:

> Overall, the results of the SOPI (Safety System Operational Performance Inspection) inspection raised concerns about the rigor of engineering efforts in general, and, in particular, with maintaining the design basis performances of safety-related pumps through an effective surveillance program. Additional concern was generated because corrective actions for prior identification of these issues were not timely.[4]

This NRC inspection report identified problems with engineering rigor and lack of timely corrective action some eight years before the Spring 2005 outage. Other examples of the existence of the same problems are found in the KNPP Operations Assessment, January 2001, the so-called GAP issues. Excerpts of this report are provided below: **[5]**

[3] Kewaunee Nuclear Power Plant, RCE 685 Flooding Mitigation / Controls Systems Root Cause Evaluation, dated July 22, 2005, page 19
[4] Letter from Geoffrey E. Grant, NRC Director of Division of Reactor Safety, to M. L. Marchi, Manager, Nuclear Business Unit, Wisconsin Public Service Corporation, dated March 28, 1997, Subject: NRC Inspection Report 50-305/97002 and Notice of Violation
[5] Assessment # K-SA-OPS-01-01, KNPP Operations Assessment, Revision 0, January 18, 2001

- Station standards for the Conduct of Operations are not clearly established and the current Conduct of Operations lags the rest of the industry in some important areas.

- The station's backlog of corrective actions has been continuously growing since formal tracking began in 1996. Numerous gaps in the corrective action process have recently been filled; however, these changes will cause a large increase in evaluations and corrective actions that will require substantial additional resources to address. The timeliness of evaluations and corrective actions is poor.

- No change management process is in place to guide major station changes.

- Other engineering challenges include large calculation and corrective action backlogs, inadequate system performance monitoring and trending, and weakness in implementing plant physical changes. Furthermore, the KNPP design basis is not well documented, is not defined and is difficult to find.

This assessment found major deficiencies in many of the same areas identified in the Commitment List including:

- Calculation backlogs
- Oversight and implementation of the modification process
- Design Basis Document and System Description revision/update and maintenance
- Corrective Action Program timeliness and effectiveness

The GAP assessment estimated that over the next five years (beginning in 2001) $25.2 million in one-time expenditures and $7.8 million in annual expenditures beginning in 2002 would be required to resolve these issues. These expenditures have apparently been ineffective. The concerns and issues identified in the March 18th Commitment List have been well documented in many prior assessments and NMC management has been unable to correct these problems. This failure ultimately led to the Spring 2005 outage**.**

V. CONCLUSIONS AND RECOMMENDATIONS

Q. BASED ON YOUR REVIEW, WHAT ARE YOUR CONCLUSIONS AND RECOMMENDATIONS CONCERNING THE SPRING 2005 OUTAGE AT THE KEWAUNEE NUCLEAR POWER PLANT?

A. At the time of the NRC High Risk / Low Margin inspection, long-standing technical and management problems existed for which prior corrective actions had been ineffective. Following this inspection, NMC decided that an extensive program to essentially revalidate the design and installed equipment and to demonstrate that management was capable of safely operating the plant was necessary to demonstrate the safety of the plant to both the NRC and the plant owners. This program included many essential areas of safe nuclear plant operation as discussed above including:

- Operations Leadership – improve conduct of operations, operational leadership and operability determinations.
- Configuration Management – extent-of-condition reviews to revalidate plant design, AFW and Turbine Building flooding, revalidate design basis documentation, revalidate AC and DC electrical calculations.
- Engineering Effectiveness – improve quality of engineering, improve understanding of design and licensing bases.
- Corrective Action Program Effectiveness – validate screening and significance level of problems, assure that managers recognize the significance of long-standing issues, ensure that corrective actions

effectively address problems, ensure timely resolution of significant issues.

- Manager / Supervisor Effectiveness – establish high standards of performance, hold employees accountable, provide necessary tools and infrastructure, improve leadership capabilities, improve oversight, utilize conservative decision-making.

Q. WOULD REASONABLE AND PRUDENT MANAGEMENT HAVE ALLOWED THE CONDITIONS DESCRIBED ABOVE TO DEVELOP?

A. No. Reasonable management would have taken timely and effective corrective action to prevent development of the conditions that led to the need for the correction of the extensive programmatic and management failures as described in the March 18th Commitment List. NMC management was imprudent in allowing the quality and effectiveness of critical programs and processes to decline to the point that the extensive effort outlined in the March 18th commitment letter was necessary to convince the NRC and plant owners that the plant design was understood, the plant was capable of safe operation and that NMC personnel were capable of managing and operating the plant safely.

Q. WERE THESE PROBLEMS CAUSED SUDDENLY BY FORCES BEYOND MANAGEMENT'S CONTROL OR REASONABLE FORESIGHT?

A. No, they were not. As described above, many of the problems were long-standing and were the result of NMC taking a minimalist approach to engineering and failure of the management and the corrective action program to recognize the

significance of issues and to take timely and effective corrective action. The causes of these problems were clearly within NMC's ability to control and foresee. WPSC ratepayers should not bear the additional replacement power and additional fuel costs resultant from this outage.

Q. COULD REASONABLE AND PRUDENT MANAGEMENT HAVE PREVENTED THIS OUTAGE?

A. Yes. Despite many indications as far back as the 1970s, lack of engineering knowledge and understanding in critical areas and the inability to correct this deficiency resulted in the AFW problems that caused the plant to shut down. The following description and chronology of these failures is summarized on page 36 of RCE 677 / 681 (Exhibit____WRJ-11).

> However, upon review of these improvements, it is clear that the site has been taking a minimalist approach to resolving issues. This could be indicative of the site having a lack of commitment to improve processes. Based on actions taken and being taken and the fact that the site is typically fulfilling the commitments that have been made, this does not appear to be the main contributor in this event. Rather than being a driver, it appears that it is allowing the real root of this issue to continue to propagate, which is that Engineering had a lack of knowledge and understanding of what constituted a proper rigor of analysis, review, or documentation when answering issues related to design basis for the AFW pumps.
>
> There was a lack of rigor in analysis and review to appropriately determine the scope and understand the significance of the work needed when first looking at the HELB requirements for the AFW pumps in the early 1970s. There was a lack of rigor in analysis and review needed to ensure that all failure modes were addressed during the sites response to GL-4 from the 1980s to the 1990s.
>
> From the 1980s to the 1990s, there was a lack in rigor needed to document and review actions taken related to the

> commitment made to the NRC to install the AFW low suction pressure trips and to follow up with the NRC after the choice was made to not pursue that option. There was a lack of rigor in the analysis, review and level of documentation needed to adequately justify changing the scope of DCR 2668 from the suction pressure trips to the discharge pressure trips in 1993.
>
> There was a lack of rigor of analysis, review and quality of documentation for OPR 000087 that resulted in three official revisions and a fourth unofficial revision, that was required to ensure that the plant made a conservative call on whether the pumps should have been called operable but non-conforming or inoperable, both by the personnel involved in providing the analysis (Engineering) and the personnel required to act on that analysis (Operations).

A minimalist approach to resolving issues and lack of commitment to improve processes, as illustrated in the failure to resolve the AFW pump issues that existed since the 1970s, does not represent reasonable and prudent management of a nuclear power plant. Kewaunee management's inability to identify and effectively resolve problems in a timely manner, ineffective configuration management, ineffective operations leadership, minimalist approach to engineering and lack of effective and conservative decision making are clear indications of imprudent management.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.